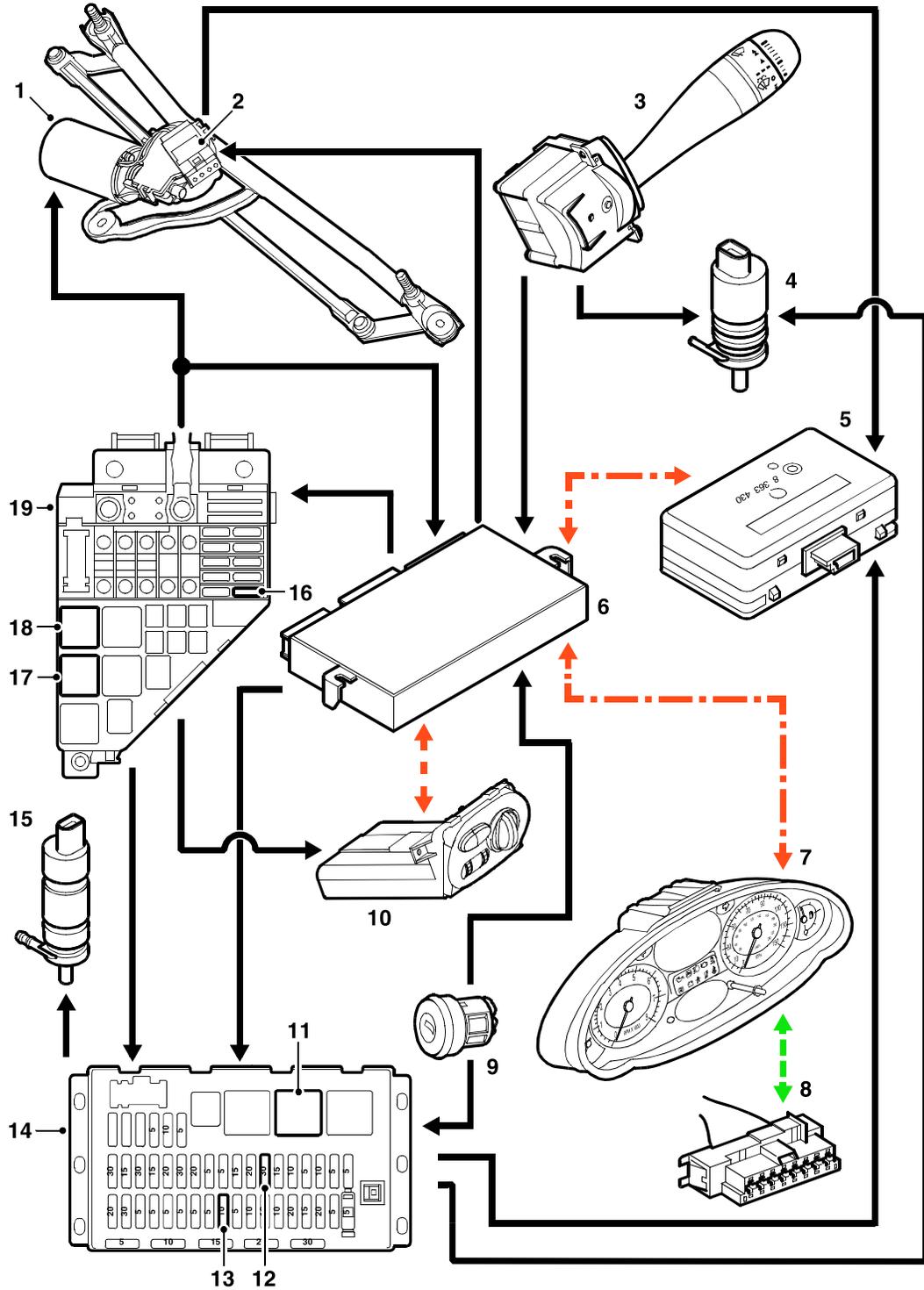




Wipers and washers control diagram



M84 0344

A = Hardwired; B = K Bus; C = Diagnostic Bus

## WIPERS AND WASHERS

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- 1 Wiper motor
- 2 Wiper motor park switch
- 3 Wiper column stalk switch
- 4 Washer pump
- 5 Rain sensor
- 6 Body Control Unit (BCU)
- 7 Instrument pack
- 8 Diagnostic socket
- 9 Ignition switch
- 10 Light Switch Module (LSM)
- 11 Powerwash/alarm horn relay
- 12 Powerwash pump Fuse 30 (30A)
- 13 Washer pump Fuse 9 (10A)
- 14 Passenger compartment fusebox
- 15 Powerwash pump
- 16 Wipers Fuse 10 (20A)
- 17 Wiper enable relay
- 18 Wiper relay
- 19 Engine compartment fusebox



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## Description

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### General

The wipers and washers system is controlled by the Body Control Unit (BCU) on receipt of requests made by the driver or the rain sensor unit (if fitted). All wiper functions are controlled from a multifunction wash/wipe stalk switch assembly located on the right hand side of the steering column.

The wipers and washers system comprises:

- A wiper motor
- A wiper linkage
- Two wiper arms and blades
- Two washer jets
- A washer reservoir and pump
- A wiper column switch

Several additional optional items are available to enhance the wiper system. These comprise:

- Heated washer jets
- Headlamp powerwash system
- A rain sensor to automatically control the intermittent function

The wiper functions operate with the ignition switch in the 'AUX' or 'IGN' positions. All wiper functions are suspended during engine cranking. Refer to 'Body Control Unit section - Power down under load' for further details.

 **BODY CONTROL UNIT, DESCRIPTION AND OPERATION, Description.** Diagnostic information on the wipers and washers system can be retrieved using TestBook.

### Wiper functions

The wiper system supports the following functionality:

- Programmed wash/wipe
- Headlamp powerwash (if fitted)
- Flick wipe
- Slow speed wiper
- Fast speed wiper
- Intermittent wipe
- Intermittent delay adjustment

#### ***Programmed wash/wipe***

The programmed wash/wipe function is controlled by the BCU. When the non-latching switch is operated, the washer pump will immediately operate to spray washer fluid onto the windscreen via the washer jets. The washer pump will be powered for a minimum of 750 milliseconds, after which, if the switch is still operated, the BCU will initiate wiper operation at slow speed for three full wipe cycles and stop when the motor reaches the park position. The washer pump will operate for as long as the switch is held and the three final wipe cycles will not start until the switch is released.

If another wiper function is selected before the programmed wash/wipe has completed its cycle, the selected function will cancel the programmed operation and the requested function will continue to operate.

#### ***Headlamp powerwash (if fitted)***

The headlamp powerwash operates when programmed wash/wipe is selected and the headlamps are on. The powerwash pump is energised for 750 milliseconds and emits a high pressure jet of washer fluid at each of the four headlamps. To preserve washer fluid, the powerwash is suspended on the next four subsequent programmed wash/wipe requests and only operates on every fifth operation of the programmed wash/wipe function.

#### ***Flick wipe***

When the non-latching switch is operated and quickly released, the wipers will complete one full cycle at slow speed. If the switch is operated and held, the wipers will operate at fast speed for as long as the switch is operated. When the switch is released, the wipers will complete the cycle at slow speed until the motor reaches the park position.

## WIPERS AND WASHERS

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### ***Slow speed wipe***

When the switch operated to the latched slow speed position, the wipers will operate continuously at slow speed. When the switch is moved to the off position, the wipers will complete the cycle at slow speed until the motor reaches the park position.

The slow speed wipe is also governed by a speed dependant feature controlled by the BCU. If the wiper switch is in the slow position and the vehicle speed falls to less than 5 mph (8 km/h), the wipers will change to normal intermittent operation with a delay appropriate to the intermittent rotary switch setting or, if the vehicle is fitted with a rain sensor, to a delay determined by the sensor.

### ***Fast speed wipe***

When the switch is operated to the latched fast speed position, the wipers will operate continuously at fast speed. When the switch is moved to the off position, the wipers will complete the cycle at slow speed until the motor reaches the park position.

The fast speed wipe is also governed by the speed dependant feature. If the wiper switch is in the fast position and the vehicle speed falls to less than 5 mph (8 km/h), the wiper speed will change to slow speed. At speeds above 5 mph (8 km/h) the wipers will resume normal speed dependant operation.

### ***Intermittent wipe***

The intermittent wipe function is controlled by the BCU. When the switch is operated to the intermittent position, the BCU measures the resistance of the rotary switch position and selects a timer relating to that resistance. The switch has four delay selections and the resistance and delay period for each position is shown in the following table.

Switch position	Resistance k $\Omega$	Delay - seconds
1	1 to 3	17
2	3 to 5	11
3	5 to 7	6
4	7 to 9	3

When the BCU timer reaches the end of the selected delay period, the wipers will operate for one complete slow speed cycle and stop at the park position. The BCU will then start the timer to initiate the selected delay period before operating the wipers again.

If a longer delay period is selected when the intermittent function is active, the longer delay will be initiated at the next wipe cycle. If a shorter delay period is selected, the wipe cycle will operate immediately after the selection.

If a programmed wash/wipe function is requested when intermittent is selected, the wash/wipe cycle will occur as described previously and the intermittent function will resume when the motor reaches the park position at the end of the wash/wipe cycle.



**Intermittent wipe with speed dependant function**

The configurable speed dependant intermittent wipe function is controlled by the BCU which also uses K bus vehicle speed signals from the ABS ECU to control the wiper delay period. When the switch is operated to the intermittent position, the BCU measures the resistance of the rotary switch position and simultaneously monitors the vehicle speed signals from the ABS system. Using this information, the BCU adjusts the delay period according to the vehicle speed. The switch has four delay selections and the resistance, speed and delay period for each position is shown in the following table.

Speed mph (km/h)	Switch Position (Resistance kΩ)			
	1 (1 to 3)	2 (3 to 5)	3 (5 to 7)	4 (7 to 9)
	Delay - seconds			
<5 (<8)	26	17	10	5
<20 (32)	19	12	6	3
<40 (64)	17	11	6	3
<57 (92)	15	10	5	2
<80 (128)	15	9	4	2
>80 (128)	13	7	3	2

If a longer delay period is selected when the intermittent function is active, the longer delay will be initiated at the next wipe cycle. If a shorter delay period is selected, the wipe cycle will operate immediately after the selection is made.

If a programmed wash/wipe function is requested when intermittent is selected, the programmed wash/wipe will operate as described previously. The intermittent function will resume when the motor reaches the park position at the end of the wash/wipe cycle.

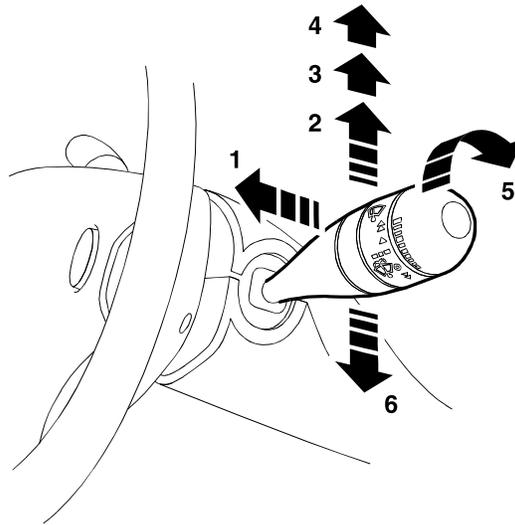
**Intermittent wipe with rain sensor**

The intermittent wipe function with a rain sensor fitted is controlled by the BCU and the rain sensor unit. When the switch is operated to the intermittent position, the BCU will initiate one complete wipe cycle to calibrate the rain sensor. The rain sensor continually monitors the rainfall or screen wetness over the optical area of the sensor and operates the wipers intermittently or continuously as appropriate. A photoelectric cell increases the sensitivity of the sensor in poor conditions or night driving to ensure that the screen remains clear. A heating element ensures that the optical element stays clear of ice and condensation. The heating element is controlled by the sensor which receives ambient temperature messages from the instrument pack on the K bus.

When the rain sensor is fitted, normal speed dependant and period adjustment intermittent operation is disabled and the rain sensor assumes full control of the intermittent wiper function.

# WIPERS AND WASHERS

## Wiper column switch



M84 0345

- 1 Programmed wash/wipe
- 2 Intermittent
- 3 Slow speed
- 4 Fast speed
- 5 Intermittent rotary switch
- 6 Flick wipe

The wiper column switch is located on the right hand side of the steering column. The switch controls the following functions:

- Programmed wash/wipe
- Flick wipe
- Slow speed wiper
- Fast speed wiper
- Intermittent wiper
- Intermittent delay adjustment

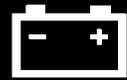
The wiper column switch comprises five switches and a rotary switch. The wiper switch positions for intermittent, slow and fast speeds are latching and the positions for flick and programmed wash/wipe are non latching.

The switches for intermittent, slow and fast speed and flick wipe all complete an earth path through the switch to the BCU on one of two wires from two switch contacts 1 and 2. The combination of earths detected by the BCU on one or both wires signals the BCU of the function selected. The combinations are shown in the following table.

Switch position	Switch 1	Switch 2
Off	0	0
Flick wipe	1	1
Intermittent	1	0
Slow speed	0	1
Fast speed	1	1

0 = Open circuit 1 = Closed circuit

The switch for the programmed wash/wipe, when operated, completes an earth path through the switch from the BCU and the washer pump on a single wire. The completed earth path signals the BCU that programmed wash/wipe has been requested and the wipers are operated accordingly. The earth path also energises the washer pump for the duration that the earth path is complete.



The intermittent rotary switch completes an earth path through the switch from the BCU. The earth is passed through resistors within the switch and, depending on switch position, the resistance is measured by the BCU. The resistance measured is used by the BCU to determine the selected delay period.

### **Wipers**

The wiper motor is located below the plenum grill at the base of the windscreen. The motor is attached to a linkage which in turn is attached to a bracket between the inner and outer bulkheads. The motor and linkage assembly is handed for left and right hand drive vehicles.

The motor comprises a dc motor which drives a gear wheel via a worm drive attached to the motor spindle. The gear wheel is attached externally to the linkage which drives each of the wiper arms attached to wheel boxes at each end of the linkage.

The motor receives two feeds from a four pin connector from the harness. One feed is a 12 V direct supply which operates the motor at fast speed. The second feed is also a 12 V supply through a resistor to the motor. This reduced voltage operates the motor at slow speed. The motor is earthed through the motor body to a track on the internal gear wheel. The track is connected to the harness connector.

A fourth pin from the connector is also connected via a contact to the gear wheel track and operates the motor park switch. The track is a short section which is connected to the earth track. A feed is supplied from the BCU to the park track contact and when the wipers reach the park position, the track completes the circuit, signalling the BCU that the wipers are in the park position. This signal is also used by the rain sensor when fitted.

The wiper arms are positively located on hexagonal drive spindles on the wheel boxes. An insert is located on each hexagonal spindle and its outer diameter mates with tapered splines in the wiper arm. A securing nut is screwed onto a threaded portion of the spindle and drives the insert into positive engagement with the splines in the wiper arm. Each wiper arm has a pivot point between the wheel box attachment and the arm itself. A spring is connected to each side of the pivot point and applies pressure to keep the wiper blade on the windscreen.

The wiper blades are attached to the wiper arms with clips that allow the blade to pivot. Each wiper blade comprises a number of levers and yokes to which the rubber wiper blade is attached. The levers and yokes ensure the pressure applied by the arm spring is distributed evenly along the full length of the blade. The driver's side wiper blade is fitted with an aerofoil which presses the blade onto the screen at high speed.

### **Windscreen washers**

The windscreen washer system comprises a reservoir, a washer pump, two washer jets, a non-return valve (NRV) and hoses.

The reservoir is located in the lower front left hand side of the engine compartment and has a capacity of 10.6 pints (6.0 litres). A filler neck, with a sealing cap, is accessible in the engine compartment for replenishing the reservoir with a mixture of clean water and washer additive. The reservoir also locates the washer pump which is sealed into the reservoir body with a rubber grommet.

The washer pump, when operated, draws fluid from the reservoir and passes it under pressure to the washer jets via a hose and a NRV. The NRV prevents fluid draining from the jets and the hose back to the reservoir and ensures that the washers operate immediately when requested.

Two washer jets are located on the outer surface of the bonnet. Heated washer jets are available as an optional fitment and prevent the jets freezing in very cold conditions. The heated jets are supplied with a power feed at all times when the ignition is on.

A washer fluid level sensor is located in the base of the reservoir. When the fluid level falls to a level below the sensor, an earth path is completed which illuminates a low washer fluid warning lamp on vehicles with a low line instrument pack or displays a low fluid level warning message on vehicles with a high level instrument pack. When the fluid level is low, the instrument pack passes a K bus message to the BCU which will suspend powerwash operation, if fitted.

The instrument pack must receive the low level signal from the sensor continuously for more than 20 seconds before the low level warning lamp is illuminated or the message is displayed. This is to prevent incorrect warnings at low fluid levels.

## WIPERS AND WASHERS

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### **Powerwashers (if fitted)**

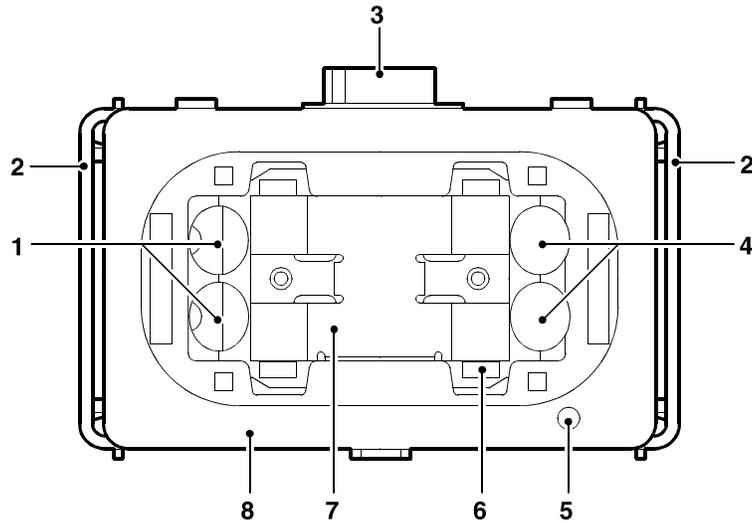
Four powerwash jets are fitted to the front bumper, one in front of each headlamp. A powerwash high pressure pump is located adjacent to the washer pump in the washer reservoir and sealed with a grommet. When the programmed wash/wipe switch is operated and the headlamps are on, the powerwash pump will be powered for a period of 750 milliseconds. The jets direct a high pressure jet of fluid at each headlamp removing dirt from the lens. An NRV is fitted between the two pairs of jets to prevent fluid returning to the reservoir.

The powerwashers are prevented from operating on every programmed wash/wipe request by software logic within the BCU. To preserve washer fluid, the powerwash is only operated on every fifth programmed wash/wipe request. The BCU counter is reset when the ignition is switched off.

When the fluid level is low and the level sensor signals the BCU, via the instrument pack, that the fluid level is low, the BCU suspends powerwash operation to preserve washer fluid.



### Rain sensor (if fitted)



M84 0346

- 1 Transmitter diodes
- 2 Retaining clip (2 off)
- 3 Connector
- 4 Receiver diodes
- 5 Light sensor
- 6 Latch clip (4 off)
- 7 Heater element
- 8 Rain sensor body

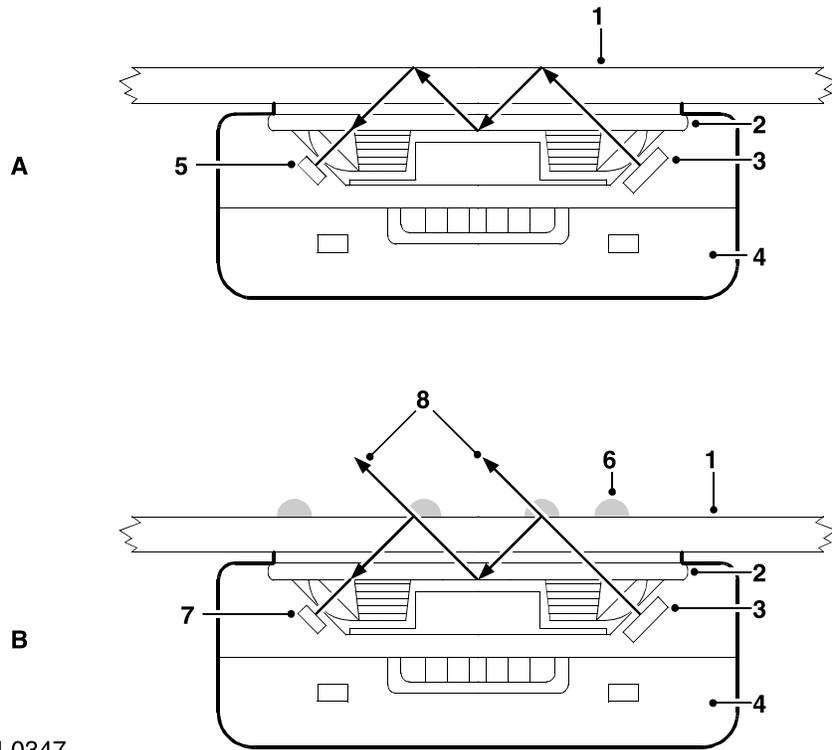
The sensor provides information to the BCU for the optimum wiper operation for the prevailing conditions to maintain the screen in a clear condition at all times. The rain sensor is an optical unit which operates on an infrared waveband. The sensor uses the principle of the laws of reflection on interfacing surfaces between materials with differing refraction indices.

The optical unit is heat bonded to the inside surface of the windscreen during manufacture and cannot be removed or replaced. If damage occurs to the optical unit or windscreen, then a new windscreen will be required and fitment can only be performed at authorised Rover dealers.

The rain sensor unit attaches to the optical unit via four clips which latch onto formed tags on the optical unit. Positive retention is achieved by two retaining clips which force the clips onto the tags. The retaining clips must be withdrawn to facilitate sensor removal.

# WIPERS AND WASHERS

## Rain sensor functionality



M84 0347

*A = Clean and dry windscreen  
B = Wet and dirty windscreen*

- 1 Windscreen - outside surface
- 2 Optical unit
- 3 Transmitter diodes (100% light transmitted)
- 4 Rain sensor unit
- 5 Receiver diodes (100% light received)
- 6 Water droplets/film
- 7 Receiver diodes (less than 100% light received)
- 8 Lost light

The sensor contains transmitter and receiver diodes which transmit and receive infrared light which is directed onto the windscreen via an optical unit. The light is directed at an angle so that the light is reflected 100% on the outside surface of the screen and is transmitted back into the optical unit. To receive a 100% reflection the screen outer surface must be clean and dry.

The light is reflected four times from when it leaves the transmitter diodes to when it is picked up by the receiver diodes. If the windscreen is wet or dirty in the area of the optical unit, the clean conditions required for 100% reflection means that some of the light reflected is lost. As the screen becomes dirtier or wetter, the received light is evaluated by the rain sensor and translated into a signal value. A micro-controller within the rain sensor monitors the change in signal and initiates the appropriate wipe cycle via K bus signals to the BCU.

The software can compensate for the long term effects scratches and stone chips in the area of the optical unit and short term effects of dirt or smears caused by worn wiper blades. A heater element is also contained within the rain sensor and uses ambient temperature K bus signals from the instrument pack to keep the optical unit clear of frost or condensation.



The sensitivity of the rain sensor can be adjusted by the driver using the intermittent rotary switch on the wiper stalk. The period between wipe cycles can be increased or reduced manually by the driver to suit prevailing conditions. In very heavy rain the sensor will operate the wipers continually. When several continuous wipe cycles have taken place, the sensor will maintain the continuous operation to avoid switching back to intermittent from a continuous wipe and back again.

The rain sensor receives vehicle speed information from the ABS ECU via the instrument pack on the K bus every two seconds. The sensor increases the sensitivity as the speed increases to optimise the wiper operation. When the vehicle speed is reduced to less than 5 mph (km/h), the sensitivity is automatically reduced. Below this speed the wipers will only operate continuously in very heavy rain.

A light sensor is incorporated into the sensor and is used to increase the sensitivity of the sensor when light levels are low. This feature counteracts the effects of rain on the windscreen affecting the driver's vision during night time driving.

### Diagnosics

A diagnostic socket allows the exchange of information between the BCU, rain sensor and TestBook. The diagnostic socket is located in the driver's footwell and is constructed to ISO standard. A dedicated diagnostic bus is connected between the socket and the instrument pack and allows the retrieval of diagnostic information and programming of certain functions to be performed using TestBook. The instrument pack forms the gateway for the K bus link to other electronic control units. The instrument pack also translates diagnostic messages from TestBook into K bus messages recognised by the system components.

The rain sensor can store fault codes which can be used to diagnose faults or non function of the rain sensor. The faults are stored in a non volatile memory which retains the logged fault codes even when the supply is disconnected. If a rain sensor fault prevents the sensor from operating, the BCU will control the wiper system as if a rain sensor is not fitted.

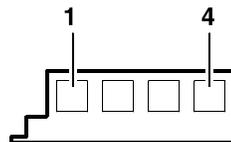
The BCU monitors all inputs and outputs related to the wiper system and other BCU controlled functions. If a fault is detected a code applicable to that fault is stored in a fault log. Two fault logs are provided within the BCU for internal and external faults. The BCU is capable of detecting open and short circuits and also incorrect K bus messages.

### Wiper system harness connector pin details

The wiper system is primarily controlled by the BCU which has three connectors which supply all inputs and outputs to and from the BCU. Refer to the Body Control Unit section in this manual for connector and pin details.

 **BODY CONTROL UNIT, DESCRIPTION AND OPERATION, Description.**

### Rain sensor harness connector C0961



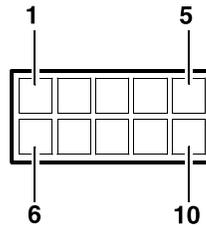
M84 0350A

The rain sensor has one harness connector C0961 and the pin details are shown in the following table.

Pin No.	Description	Input/Output
1	Auxiliary feed to BCU	Input
2	Earth	Input
3	'K' bus connection	Input/Output
4	Wiper park switch	Input

## WIPERS AND WASHERS

### *Wiper column stalk switch connector C0035*

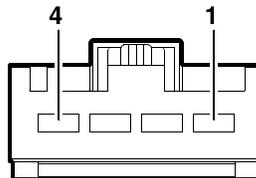


M84 0351A

The wiper stalk switch has one connector C0035, shared with other column switches. The pin details related to the wiper system are shown in the following table

Pin No.	Description	Input/Output
6	Programmed wash/wipe switch	Output
7	Column switch 1	Output
9	Column switch 2	Output
10	Intermittent potentiometer	Output

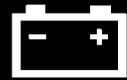
### *Wiper motor connector C0030*



M84 0352A

The wiper motor has one connector C0030 and the pin details are shown in the following table

Pin No.	Description	Input/Output
1	Park switch	Output
2	Slow wiper speed	Input
3	Fast wiper speed	Input
4	Earth	Output



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## Operation

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### Wipers

The wiper operation is controlled by the BCU using two relays located in the engine compartment fusebox. Power for wiper motor operation is supplied through fuse 10 in the engine compartment fusebox.

#### ***Slow speed operation***

When wiper slow speed operation is selected, electronic circuitry inside the BCU provides an earth path for the wiper enable relay coil. The coil energises and moves the relay contacts to allow a feed from fuse 10 in the engine compartment fusebox to pass through the enable relay contacts. The feed passes through the wiper relay and is connected to the motor via a resistor. The resistor causes the motor to operate at slow speed by reducing the current supplied. The motor is earthed through its body to an earth eyelet connector.

When the wipers are in intermittent operation, the BCU always operates the wiper motor in slow speed via the resistor. When the wipers are turned off, the BCU switches the wiper relay to complete the cycle at slow speed.

#### ***Fast speed operation***

When fast speed is selected the electronic switch energises the wiper enable relay as described for slow speed. The BCU also energises the coil of the wiper relay by providing an earth path via another electronic switch within the BCU. The feed from fuse 10 passes through the wiper relay contacts and is connected directly to the motor, by-passing the resistor used for slow speed operation. The full power available to the motor causes it to operate at fast speed.

When the wipers are operated in flick wipe mode, the BCU will operate the wipers at fast speed until the switch is released and will complete the wiper cycle at slow speed.

#### ***Park switch***

The park switch comprises an incomplete track located on the gear wheel inside the wiper motor which is connected to the motor earth track also on the gear wheel. An input from the BCU is connected to a contact in the wiper motor, which connects with the park track when the wipers reach the park position, completing an earth path from the BCU. The completed circuit provides an earth for the output from the BCU which interprets the earth as a wipers in park position signal.

### Windscreen washers

The washer pump receives a 12 V supply from fuse 9 in the passenger compartment fusebox when the ignition switch is in the AUX or IGN position. When the programmed wash/wipe is selected from the wiper column stalk switch an earth path is completed through the switch providing an earth for the pump which operates. The pump will operate for a minimum of 750 milliseconds or for as long as the switch is operated.

#### **Powerwashers (if fitted)**

A permanent 12 V supply from the battery, via fusible link 3 in the engine compartment fusebox, is connected to the powerwash relay contacts and coil in the passenger compartment fusebox. For powerwash to operate the BCU must receive a K bus message from the LSM that the headlamps are on.

When the programmed wash/wipe switch is operated, an earth path is completed from the BCU through the switch. This is interpreted by the BCU as a signal that programmed wash/wipe has been requested. If the BCU receives the lights on K bus message from the LSM, the BCU provides an earth for the coil of the powerwash relay which energises and closes the relay contacts. The feed from fusible link 3 passes through the relay contacts and fuse 30 in passenger compartment fusebox and is connected to the powerwash pump which operates. The BCU energises the coil for 750 milliseconds allowing the pump to operate to clean the headlamps.

A counter in the BCU starts and prevents further powerwash operation for the next four programmed wash/wipe switch operations. On the fifth operation of the switch the BCU permits powerwash operation and resets the counter. The counter is always reset when the ignition is switched off.

## WIPERS AND WASHERS

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### **Rain sensor (if fitted)**

The rain sensor receives a 12 V supply from fuse 12 in the passenger compartment fusebox when the ignition switch is in the AUX or IGN position. For the rain sensor to operate the wiper column stalk switch must be selected in the intermittent position.

A connection to the wiper motor park switch is monitored by the rain sensor logic to inform the rain sensor when the park switch is open or closed circuit and the wiper motor is operating or in the park position.

Intermittent wiper operation is controlled by the rain sensor via K bus signals to the BCU. The information provided on the K bus from the rain sensor determines the optimum rate of intermittent operation provided by the BCU. When the rain sensor determines that wiper operation is required, a K bus message is transmitted to the BCU which starts the wipe cycle. When the sensor receives an open circuit signal from the wiper park switch, a second K bus message is sent to the BCU to end the wipe cycle when the park switch becomes closed circuit.

The rain sensor transmits a K bus status message to the BCU every 10 seconds even if the windscreen is dry to inform the BCU that the sensor is functional. If the BCU does not receive this message after a period of 12 seconds the rain sensor function will be disabled and normal intermittent function will be enabled. If a message is received after the 12 second period, then the BCU will pass control of the intermittent function back to the rain sensor.

The sensitivity of the rain sensor can be adjusted by the driver using the intermittent rotary switch on the wiper column stalk. Sensitivity of the rain sensor is automatically reduced when the vehicle speed falls to less than 5 mph (8 km/h). The speed signal is transmitted to the rain sensor from the instrument pack on the K bus. This prevents the rain sensor operating the wipers continuously only when heavy rainfall is present.

The ambient temperature is transmitted on a K bus message every 10 seconds when the ignition is on. This is monitored by the rain sensor which operates the sensor heater element when appropriate.